

## **Idaho RII Project Summary: Managing Idaho's Landscapes for Ecosystem Services (MILES)**

Managing Idaho's Landscapes for Ecosystem Services (MILES) will advance the State's capacity to resolve the complex social-ecological processes associated with urban growth-influenced changes to ecosystem services. This knowledge will improve the ability to provide science-based decision support needed to sustainably manage Idaho's resources.

There is a critical need for fundamental science that supports the sustainable management of ecosystem services and informs sustainable policy making. Rapidly growing mid-sized urban population centers are altering proximal ecosystem services on which these communities depend, a trend of global significance. In the Western United States, the expansion of the urban interface often involves disruption of agricultural production, water resources, and amenity based ecosystem services that are driving the growth in the first place; these changes are coupled with shifts in societal demand and values. These landscape transformations are occurring against a backdrop of climate change, adding further uncertainty about the future because Idaho is highly dependent on a shrinking water supply. Idaho is in a strong position to help resolve this grand challenge because, while its cities are rapidly growing, they are medium sized (<300,000), and there is still the potential to shape development in a way that sustains future ecosystem services in areas undergoing rapid growth.

Working with community partners, Idaho MILES will utilize existing and newly acquired data on both ecological and social processes and create tools and approaches for decision support and advance SES theory. New methods will be developed to identify vulnerable ecosystem services and integrate social and ecological processes in a modeling framework to support research, outreach, and education. These tools will extend beyond the scope and duration of EPSCoR. Idaho MILES will continue a long history of university-community engagement to advance workforce development and social-ecological system (SES) science and its application to a variety of real-world scenarios. Idaho MILES is directly aligned with and responsive to growing national and global consensus that knowledge of the ways that growing human settlements affect ecosystems and the services they provide is critical to sustainability. The **vision** of MILES is for Idaho to become a leader in coupled natural-human systems research focused on understanding and managing ecosystem service change under the influence of mid-sized cities.

**Goal and Approach:** The **goal** of MILES is for Idaho to develop capacity to *create new knowledge* about ecosystem services, landscape change, and associated socio-economic systems, and to develop our ability to *provide science-based decision support* needed to sustainably manage Idaho's resources. The MILES **investment strategy** focuses on creation of human capital in social-ecological system science. Thus, the MILES research team represents a transdisciplinary group of over 35 faculty inclusive of the fields of ecology, economics, physical and social geography, hydrology, public policy, urban planning, computer sciences, communication and visualization, including 11 strategically targeted new faculty positions.

Six research objectives will guide our efforts to explicitly link social and ecological processes associated with growth of three mid-sized cities in Idaho. First, the MILES team will **Characterize Patterns of Urban Growth and Ecological Change** to quantify how growth has occurred and ecosystem services have changed over time and how that change is manifested on the landscape. Second, is to **Identify Social Drivers of Urban Growth and Ecological Change** by quantifying how social institutions make key policy decisions and how society values and perceive ecosystem services. Third, these biophysical and social datasets will be used to construct a screening tool to **Identify Vulnerable Ecosystem Services** and their associated driving variables. The premise of this screening tool is that the social and biophysical datasets contain information regarding vulnerable components of the social-ecological system that can be extracted using a rapidly applied valuation approach. Fourth, focusing on vulnerable ecosystem services, the MILES team will **Construct an Integrated Modeling Framework** that links domain specific models of biophysical (e.g. hydrology, landscape, ecosystem) and social (economic, social behavior) processes using a scenario-based formulation. This will allow evaluation of ecological and social tradeoffs associated with urban expansion and related ecosystem services. Fifth, **Visualization and Virtualization**

**Tools** will be constructed to facilitate the communication of the scenario modeling. Sixth, the resulting integrated modeling-virtualization framework will be used to **Generate and Communicate Knowledge of Social-Ecological Systems** by (a) promoting communication and intellectual exchange among researchers and students from diverse disciplines; (b) improving communication to the community about how their social-ecological system functions; and (c) providing decision makers with the best possible science to inform policy making associated with urban growth to promote sustainable ecosystem services.

**Seeding Innovation:** Building on the ‘experimental’ aspect of EPSCoR, two programs will be created to support new and innovative ideas: The **Idaho Social-Ecological Exploratory Dynamics Awards (iSEED)** is a seed research funding program designed to provide flexibility to foster and pursue collaborative science within the MILES program as our understanding of the science program and stakeholder input develops. The program will be open to all faculty across the state to foster new ideas in social-ecological sciences. It also is a key part of a strategy to increase statewide participation both number and diversity of participants The **Innovation Workshops** Program is designed to engage scientists and educators in different disciplines, along with key nationally and internationally recognized experts, in multi-day planning activities that serve as the basis for peer-reviewed publications and research and education proposals to funding agencies.

**Cyberinfrastructure:** The cyberinfrastructure plan will (1) support the MILES research mission, (2) create new knowledge in CI science and technology, and (3) build the state’s cyberinfrastructure capacity. MILES introduces significant data interoperability challenges and opportunities related to modeling and integrating data from disparate data sources, domains, spatio-temporal scales, and formats. This challenge will be addressed by actively supporting data acquisition and storage, mapping and modeling, and the construction of innovative visualization tools. These efforts will build upon previous RII investments that enabled researchers and students to share large data collections. This plan enables new and fundamental CI research in data interoperability by providing a single, well-instrumented data management platform for making data accessible across domains, formats, and spatio-temporal scales. Investments in faculty positions and, importantly, technical support staff will directly support this program and also expand the CI-related infrastructure of the state.

**Outcomes:** Our approach will reveal emergent characteristics of complex systems that will lead to: (a) a spatially-explicit, understanding of the pattern of landscape change and likely ecosystem service status for each Study Area; (b) knowledge of the socioeconomic mechanisms that may result in and respond to these patterns and changes; and (c) scenario tools that give decision-makers insight into potential futures based on verified and validated data. Outcomes will include: **(1)** The establishment of a transdisciplinary culture across Idaho that will create knowledge of social and ecological systems. **(2)** Creation of the first ecosystem vulnerability screening tool. **(3)** Creation of advanced modeled and visualized/virtualized environments that generate plausible future scenarios for use in public discourse. **(4)** Greater capacity to communicate knowledge among researchers in diverse disciplines and between researchers and the broader community through a substantial investment in visualization expertise. **(5)** A new Center for Sustainable Ecological Resources System (CeSERS), a statewide focal point for enhancing and sustaining SES research. **(6)** The newly developed Social Ecological Systems Coalition, a network of EPSCoR jurisdictions whose programs focus on SES and sustainability science, particularly in the Western States.

**Intellectual Merit:** MILES’ Intellectual Merit lies in revealing the poorly understood feedbacks between growing mid-sized cities and ecosystem services as ecosystems change. Using study areas with distinct resource issues, we can identify some of the complex interactions between human settlements and the natural resources. MILES will address conceptual challenges, including the need to incorporate a range of other relevant theories to advance SES science; the need to develop better tools for the integration of social and biophysical data; clarifying and better defining social drivers of ecosystem change; and understanding cross-scale interactions in terms of how ecosystems respond to cumulative stresses, from both inherent biophysical and specific social sources. We will also address practical challenges such as identifying what kind of change in specific ecological and social variables may lead to ecosystem

vulnerability. To accomplish these goals, we will develop and apply innovative methodologies and evolve them into sophisticated decision-support tools that can be used to inform the sustainable management of natural resources within Idaho and around the world.

**Broader Impacts:** The objective of the Diversity, Workforce Development and External Engagement Plans is to increase the number and diversity of students enrolled in and graduating with degrees related to MILES. It is critical to prepare technically competent graduates from the state's Predominantly Undergraduate Institutions (PUIs) and research universities for Idaho's STEM workforce. The RII will support up to 300 *MILES Undergraduate Research and Internships (MURI)*, with a target of half from underrepresented groups, to engage STEM undergraduates in hands-on, paid summer and academic year research experiences. A *Bridging and Learning Community* program will leverage field-based MILES experiences at each of the study sites for cohorts of college faculty, 1st year undergraduates, high school STEM teachers, high school juniors and seniors, and Idaho Public TV journalists. This program will foster broad stakeholder and public engagement. This RII has ambitious goals for recruitment and retention of women, underrepresented minority (URM) students and faculty and students from Idaho's 100 existing STEM Pipeline K-12 programs and five PUIs. The RII diversity goals will be accomplished by investing in: (1) increased recruitment and collaboration with programs that serve women, minority, and students from PUIs, (2) undergraduate research and internship experiences, (3) supplemental support for MILES faculty to recruit URM graduate students and postdoctoral fellows, and (4) supplemental funding to recruit and offer new EPSCoR faculty positions to minority candidates.

A societal benefit of the RII will be the improved public understanding of ecosystems and their services, and improved quality of life and ecosystem health as a result a greater ability to provide science-based decisions that support sustainability.

**Alignment with Idaho Research Priorities** A decade of State S&T planning has identified *Ecological Health* as a focus that leverages and builds on strengths at each of Idaho's Universities (e.g., agricultural and natural resource programs, engineering, biological sciences, public policy, and economics). This RII's **vision and scientific focus**—MILES—is a direct result of these planning efforts, and is aligned with the new *Five-Year Strategic Research Plan for Idaho Higher Education*. As a result of focusing and leveraging NSF, State, and institutional resources, and capitalizing on the inherent strengths and common priorities of Idaho's academic institutions, Idaho's intellectual capital and competitiveness continues to grow in support of state S&T priorities. MILES will build on and extend this success.

**Evaluation and Assessment, Sustainability and Management:** Planning has shaped the creation of ONEIdaho, a framework to integrate the EPSCoR-driven education and research activities statewide. *Evaluation and Assessment:* Idaho EPSCoR will utilize five comprehensive, integrated evaluation and assessment mechanisms: (1) a strategic plan and an evaluation plan with clearly defined metrics, (2) staff time dedicated to data collection, coordination, and reporting, (3) an external Project Advisory Board (PAB) of independent experts, (4) an external independent evaluator, and (5) a feedback loop to ensure appropriate and timely management responses. *Sustainability:* To sustain gains achieved through MILES and generate subsequent funding, Idaho will develop and nurture State, regional, national, and international partnerships; aid early career faculty in integrating their research into interdisciplinary and often multi-institutional efforts; and provide them with mentoring and proposal development assistance to increase competitiveness of proposals. *Management:* Dr. Peter Goodwin, one of Idaho's most distinguished scientists, will lead the RII. The Idaho Management consists of the Idaho EPSCoR Committee, Idaho EPSCoR Office, and Executive and Science Leadership Teams with overlapping membership. Idaho's Committee members are among the most influential leaders in Idaho's industry, academic, government, and private sectors. The Leadership Teams will meet (bi-monthly) to ensure intellectual guidance and coordination of the project across all components. Other senior scientists at Idaho's three universities will assist in project management and mentoring. At the successful completion of this effort, Idaho will be the home of a national Center for Sustainable Ecological Resources Systems that will lead and coordinate strategic efforts in continuing to build Idaho's research capacity.